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ABSTRACT

A study explored how writers with extensive experience and learning in an academic discipline used both topical and rhetorical knowledge to construct synthesis essays. Subjects, 20 psychology graduate students and 20 business graduate students, wrote synthesis essays on either the topics of "supply-side economics" or "rehearsal in memory." Half of the subjects completed think-aloud protocols, and their composing processes were analyzed for different qualities and frequencies of elaborations and rhetorical awareness and for task representation. Analysis of variance indicated that (1) "high knowledge" writers evidenced unique elaborative and rhetorically sensitive performance; (2) high knowledge writers included more "new" information in their essays in the top levels of essay organization; (3) low knowledge writers elaborated less but did rely on structural and content-based awareness to compose. Findings confirmed the interrelatedness of comprehension and composing processes and illustrated how writers, with varying levels of topic familiarity, use both their knowledge of disciplinary topics and their experience as readers and writers to compose synthesis essays. (Fifteen tables of data, four figures, and one note are included; 180 references and two appendixes of data are attached.) (RS)

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Center for the Study of Writing

Technical Report No. 40

READING, WRITING, AND KNOWING: THE ROLE OF DISCIPLINARY KNOWLEDGE IN COMPREHENSION AND COMPOSING

John M. Ackerman

March, 1990

University of California, Berkeley
Carnegie Mellon University

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Abstract

To explore how writers, with extensive experience and learning in an academic discipline, used both topical and rhetorical knowledge to construct synthesis essays, 40 graduate students, equally representing the two disciplines of psychology and business, wrote synthesis essays on either the topics of "supply-side economics" or "rehearsal in memory." Half of the writers completed think-aloud protocols, and their composing processes were analyzed for different qualities and frequencies of elaborations and rhetorical awareness and for task representation. Their written products (40 essays) were analyzed for the importance and origin of information and for the quality of key rhetorical moves. Analyses of variance revealed that "high-knowledge" writers evidence unique elaborative and rhetorically-sensitive performance, although awareness of "structure" and "content" were more sensitive to specific topics and disciplines. They also included more "new" information in their essays in the top levels of essay organizations. Low-knowledge writers elaborated less, but did rely on structural and content-based awareness to compose, and included comparable amounts of "borrowed-implicit" information in their essays. Intercorrelations of process and product features revealed that evaluative elaborations and awareness of rhetorical context corresponded with the presence of new information in essays for all 40 writers. The findings confirm the interrelatedness of comprehension and composing processes and illustrate how writers, with varying levels of topic familiarity, use both their knowledge of disciplinary topics and their experience as readers and writers to compose synthesis essays.

READING, WRITING, AND KNOWING: THE ROLE OF DISCIPLINARY KNOWLEDGE IN COMPREHENSION AND COMPOSING

by

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In a country which has increasingly turned its attention to literacy as a cultural and societal issue (e.g., Hirsch, 1987; cf. Rose, 1989), it is perhaps not surprising that educational researchers have examined reading and writing as companion processes. Both modes of communication (and speaking) are essential for participation in a literate culture (Olson, 1977), and reading and writing curricula symbolize how educational systems value and promote literate practice (Castell & Luke, 1988). Although literacy by definition embraces reading and writing ability, literacy theory also attempts to account for the prior knowledge of the composer, i.e., the experience and learning readers and writers bring to meaning making. Many theorists and practitioners have acknowledged the role of reading and writing in mediating experience in classroom settings (e.g., Newkirk, 1986; Petrosky, 1984); however, a theoretical position which represents both modes of communication as companion, constructive, and knowledge-driven processes has only recently begun to emerge.

Constructivism[1] has been proposed as a theory to account for the role of prior knowledge in reading and writing (Shanklin, 1982; Spiro, 1980; Spivey, 1987; cf. Bracewell, Frederiksen, & Frederiksen, 1982). In terms of reading research, the constructivist perspective began with Barlett's (1932) notion of the schema and posits a reader who actively constructs meaning by connecting and integrating old knowledge with newly encountered information in texts (for related reviews, see Anderson & Pearson, 1984; Calfee & Drum, 1986; Tierney & Cunningham, 1984). Schema theory (Rumelhart, 1980; Rumelhart & Ortony, 1977) is actually one of a number of theories of the old knowledge, conceived as knowledge structures, that readers bring to composing including frames (Minsky, 1975), scripts, plans (Schank & Abelson, 1977), story grammars (Mandler & Johnson, 1977), and domains of expertise (Larkin, McDermott, Simon, & Simon, 1980).

Generally, this knowledge functions as the raw material for a reader's inferencing processes which have been found to guide comprehension, for example, when readers confront ambiguous text (Anderson, Reynolds, Schallert, & Goetz, 1977) or text which is less familiar (Bransford & Johnson, 1972; Collins, 1978). Elaboration theory proposes to account for more idiosyncratic associations which cannot be explained by other theories of knowledge structure and activation (cf. Frederiksen, 1972, 1975a,b). Reder (1980) describes elaborations as "extra processing ... that results in additional, related, or redundant propositions" which can aid memory and retrieval (p. 7). Expert readers have been shown to use their prior knowledge in various ways: as "structure strategies" (Meyer, Brandt, & Bluth, 1980), as "importance" criteria (Kieras, 1985; McKoon, 1977), and as an overriding "perspective" on a topic (Anderson & Pichert, 1977). A reader's perspective can function as a goal for comprehending (Just & Carpenter, 1980) which in turn affects the attention allocated (Goetz, Schallert, Reynolds, & Radin, 1983) or the information recalled (Pichert & Anderson, 1977; cf. Reynolds, 1981).

There are clear benefits to a constructivist perspective on reading comprehension. First, it has provided a theoretical basis for explaining individual differences in comprehension such as forming inferences, making relevance judgements, and recalling information (Spiro & Myers, 1984). It also supports interactive theories of reading comprehension where processing is both text-driven and knowledge-driven (Rumelhart, 1977). And, from a practical standpoint, it has led to alternatives to a discrete, skills-based curriculum in teaching methods, alternatives such as main idea strategies (Afflerbach, 1986) and learner-generated questions (Brown & Palincsar, 1985).

The constructivist tradition in writing research and theory has not surfaced explicitly but can be construed from recent work grounded in cognitive theory (for related reviews see Hillocks, 1986a; Scardamalia & Bereiter, 1986; Witte & Cherry, 1986). Scardamalia and Bereiter (1985) and Hillocks (1986b) proposed that a writer's knowledge and performance are directly related in that expert writers draw upon declarative and procedural forms of both topic and rhetorical knowledge. By wedding the philosophical and psychological distinction between *knowing how* and *knowing that* (Anderson, 1983) to types of writerly knowledge, a writer's ideas and rhetorical and linguistic skill are conceived as being interactive and interdependent. To explore how writers use prior knowledge of topic and composing, McCutchen (1986) proposed a theoretical distinction among three kinds of knowledge—content, plans, and discourse. In an experimental study, high and low-knowledge writers at three elementary grade levels composed on the topic of football. McCutchen concluded that there do indeed appear to be multiple sources of knowledge comprising the skill a writer brings to composing. High topic knowledge contributed to coherent, elaborated, and specific ideas in essays, and the "content component" in McCutchen's theoretical model appeared to be an especially powerful predictor of good writing. She also concluded that the "discourse component" may "compensate" somewhat for lack of topic knowledge.

Prior knowledge has been represented as a key component in models of the composing process. Flower and Hayes (1981) proposed that the writer's memory interacts with the writing process and the task environment. Similarly, in Beaugrande's (1984) model of text production, "ideas" interact with goals, conceptual development, expression, and linguistic considerations. Importantly in these models, "ideas" are not static or a priori considerations, and the degree and manner to which a writer knows something has equal and active play with creativity in the composing process. Flower and Hayes (1984) later hypothesized that meaning resides in a writer's mind in the form of multiple representations. The multiple representation hypothesis extends the declarative and procedural distinction by acknowledging the role of mental representations in writing. Task representations have been described as an interpretive process where writers construe a task to reflect their prior experience, strategies for composing, and goals (Flower, 1987; cf. Ackerman, 1989a).

Researchers and theorists interested in writing and learning have also linked knowledge with composing but have emphasized the knowledge gained or restructured from the practice of composing. The form or aim of writing, such as writing to summarize or analyze, apparently influences the effectiveness of writing as aid to learning (Bretzing & Kulhavy, 1981; Marshall, 1987), and the various aims of writing invoke different thinking strategies: the more integrative and analytic the thinking process, the richer the writer's representation of the topic and potentially the stronger the recall (Langer, 1980, 1986; Newell, 1984). However, when writing is compared with other learning tasks, such as notetaking, rereading, or multiple-choice questions, the effectiveness of writing as an aid to learning varies accordingly (Copeland, 1985; Penrose, 1987; Taylor, 1984). In a comprehensive study of writing and learning in 18 classroom contexts, Langer and Applebee (1987) found that learning by writing was not only influenced by the purpose of

the assignment and the nature of the material, but also each teacher's "configuration" of goals, instructional approach, and method of evaluation.

Just as writing has been equated with learning, writing has also been proposed as a path to "higher order" reasoning (Applebee, 1984). Durst (1985, 1987) studied analytic writing by contrasting high and average-ability writers who were given summary and analytic writing tasks. He found that students writing analytically employed varied and more complex cognitive operations, focusing on intermediate and global issues in the readings, attending more to their own writing processes. In their essays, students writing analytically tended toward more abstract interpretations of their content with more evaluation (instead of description) and with slightly more coherence. These findings appear to drive a wedge between analytic and summary thinking, but as Durst points out, the gap between analytic and summary skills is less apparent in the final products as all writers in his study relied on narrative patterns to complete the task. Analytic writing does, however, appear to require knowledge of appropriate rhetorical conventions, familiarity with the central issues, claims, and counterclaims in a topic, and the ability to "contextualize" their thinking.

There are clear benefits for construing composing as a knowledge-driven, constructivist activity. The research reviewed thus far suggests that writing is far from a skills-based faculty and acknowledges the varied background and experience that writers bring to composing as well as the influence prior knowledge has on various cognitive operations. Several models have been proposed which begin to clarify the role of prior knowledge in both comprehension and composing. Kucer (1985) outlined three "cognitive universals": both reading and writing access background knowledge, knowledge instantiation is guided by context, and readers and writers use generative, integrative, and selective strategies. Tierney and Pearson (1983) proposed that reading and writing share similar cognitive processes of planning, drafting, aligning (choose an authorial stance), and revising an emerging notion of a text's meaning. Two research teams have used discourse as well as process features both to conceive of and examine reading and writing relationships. Bracewell, Frederiksen, and Frederiksen (1982) proposed that readers and writers construct "frameworks" for comprehending and composing which combine knowledge of framing structures with inferencing processes. Shanahan (1984) and Shanahan and Lomax (1988) tested models based on interrelationships between reading and writing and concluded that an interactive model best accounts for how information transfers between modes as people develop these abilities.

While models of reading and writing provide "metaphors" of complex processes (Flower & Hayes, 1981), few researchers have used prior knowledge as a variable in comprehension and composing. An exception, Langer investigated the relationship between "background knowledge" and text comprehension and recall (1980, 1984a) and then between background knowledge and writing quality (1984a,b). At the heart of this research was a knowledge measure developed to categorize and rank a writer's topic-specific knowledge in advance of composing (Langer & Nicolich, 1981). Langer found a strong relationship between the specific structure of a writer's prior knowledge and the quality of the writer's essay, and that this relationship varies depending upon the writing task. Langer (1984a) further concluded that topic-specific background knowledge "may be more consistently helpful to readers than to writers" (p. 42), again pointing to variability in writing tasks.

Spivey (1983) sought to investigate comprehension and composing by studying a unique and important task, "discourse synthesis" which posits writers who read to compose "second-order discourse" from multiple sources. She compared able and less-able comprehenders who synthesized three descriptive texts, and she found that the able

comprehenders produced texts which had more content, were more unified and connected, and were based on across-text, important information. There was, however, little difference between able and less-able comprehenders in the process measures (cf. Kennedy, 1985). In a later developmental study, Spivey and King (1989) replicated many of Spivey's earlier findings: able readers across three grade levels (6-8-10) constructed texts which were more elaborate, more tightly organized, and better connected and were given a higher over-all rating.

Collectively, these studies and theories have informed literacy theory by proposing and examining how prior knowledge influences reading and writing. However, they have done so by typically examining the role of prior knowledge in reading or writing separately. Reading researchers in the constructivist tradition have amply demonstrated the importance of prior knowledge in comprehension but generally have not branched out to explore writing as a product of comprehension and tend to hold to a single-text research paradigm (Whitney, 1987). Researchers on writing and learning and analytic writing have shown that performance varies with tasks and contextual factors, but they tend not to consider reading as a factor in knowledge change or as a companion process to writing. Similarly, researchers who assume that prior knowledge does influence composing and include knowledge as a researcher factor tend to not include a reading component or account for the role of comprehension processes in composing. Only the research on discourse synthesis so far has attempted to bridge comprehension and composing processes directly and study complex, intertextual tasks (Beaugrande & Dressler, 1981; cf. Rowe, 1987), although Spivey's (1983) research was limited to descriptive texts and did not explicitly account for the prior knowledge brought and applied to the synthesis task. A complement to the existing research on reading, writing, and knowing would be research which contrasts different levels of prior knowledge and which illustrates how prior topic knowledge influences both comprehension and composing processes in multi-text tasks.

Purpose and Research Design

The present study is an attempt to describe how extensive knowledge of an academic topic matters to writers composing from multiple sources to synthesize the claims and evidence of published "authorities" with their own ideas and beliefs. In this research, reading and writing are assumed to be constructive processes, and comprehension and composing are guided by a writer's prior knowledge as well as by rhetorical intentions and decisions. Thus, this research both foregrounds the knowledge a composer brings to a literate event and places the composer at the center of literate practice (Purves & Purves, 1986).

How researchers define "prior knowledge" has implications for the selection of instruments, interpretation of the findings, and more generally where a study is located in a theoretical field. Although a constructivist perspective may posit the active use of various knowledge structures, other theorists have argued against a foundationalist notion of knowledge, preferring to view knowledge as a social and cultural construct (Berlin, 1988; Rorty, 1982). In this study, prior knowledge was assumed to accrue from years of exposure to and participation in a discipline, but also to operate cognitively in comprehension and composing. Forty graduate students from two academic disciplines were asked to write either on a topic in their chosen field or out, yielding a between-subjects, 2 x 2 contrast of discipline and topic and providing a comparison of "high-knowledge" and "low-knowledge" writers. Both composing process and written product measures were analyzed with Elaborations, Rhetorical Awareness, and Task Representation serving as the process measures and Importance and Origin of information and key Rhetorical Moves serving as product measures (Ackerman, 1989b). A balanced

subset of 20 subjects completed think-aloud protocols to help determine the degree to which "thinking aloud" was an intrusion (Cooper & Holtzman, 1983).

The general hypothesis for this study was that prior knowledge of a disciplinary topic would influence composing processes and products. Because this research is primarily descriptive, the analyses were conceived and arranging according to the following research questions:

1. Will writers composing on a familiar disciplinary topic evidence different composing processes: will the frequencies and qualities of elaborations and rhetorical awareness vary from writers composing on a less-familiar topic?

2. Are there differences in task representation when writers of different disciplines compose on familiar versus less-familiar topics, and is there any evidence that these representations lead to performance differences?

3. Will writers composing on a familiar disciplinary topic produce different written products: will they select information from source texts and their prior experience and learning differently, and will they place that information differently in their essay organizations?

4. Are differences in the rhetorical moves used to construct synthesis essays associated with writers' familiarity with a topical domain?

5. Do key process and product features—presumably elaborations, rhetorical awareness, and importance and origin of information—intercorrelate?

Research Methods

Subjects

Graduate students were chosen as subjects because they were assumed to have a sense of authority, from their immersion in a discipline-specific subject area, and to be "accomplished" readers and writers (Afflerbach, 1985). The disciplines of psychology and business were compared because their graduate programs value similar forms and uses of academic writing (Bridgeman & Carlson, 1984) while the disciplines themselves remain distinct in terms of scholarly issues, methodological preferences, and arenas for publication. Potential subjects at Carnegie Mellon University and the University of Pittsburgh were screened for English as a first language, for topic familiarity, but not for specific reading or writing ability levels. Each potential subject answered general questions about the two topics and about the authors and key ideas in the source texts. The interviewing and screening procedure continued until (80% acceptance rate) 20 subjects from each discipline were found who were then randomly assigned to compose on either Rehearsal in Memory or Supply-side Economics.

Materials and Procedures

The topics are common areas of discussion and specialization within the two disciplines and were chosen after reviewing descriptions of graduate programs in psychology and business and after consulting with faculty in the two fields. The topics also retained a common, public appeal in that "memory" and "economics" are general topics which transcend disciplinary and academic boundaries. To write their syntheses, subjects

read four intact passages for each topic with comparable length, variety of information, and percent of repeated ideas (crudely representing the amount of common information across a collection). The passages offered varied perspectives and rhetorical approaches and also contained comparable amounts of visual information, i.e., figures, graphs, and equations. Some variance in essay length was necessary to maintain the completeness of subsections (Table 1).

Table 1
Source Texts: Length, Syllable/Sentence Ratio, and Repeated Ideas

		Word Length	Syl/Sent. Ratio	Repeat Ideas
Supply-side Economics				
Text A Klein	Economics of Supply and Demand	924	51.3	23 %
B Brookes	The Economy of Mind	660	41.6	24 %
C Lipsey, et al	Supply-side Economics	878	33.3	29 %
D Evans	The Truth about Supply-side Economics	1596	50.2	10 %
	Mean	1015	44.1	20 %
Rehearsal in Memory				
Text A Norman	Memory and Attention	518	38.7	41 %
B Anderson	Architecture of Cognition	1170	42.3	02 %
C Bransford	Human Cognition	996	30.3	18 %
D Newell & Simon	Human Problem Solving	532	37.4	05 %
	Mean	804	37.2	20 %

Besides four passages, each writer received task directions and a composing scenario: students wrote essays as part of an application for a "scholarship which will provide additional support for (their) studies," an open-ended task in that a synthesis of the "enclosed passages and your own ideas" was not further defined. Writers assigned to the protocol condition were trained and, to reduce the amount of interference from the requirement to "keep talking" while reading, were instructed to first read through the passages uninterrupted except for periodic prompts to stop and reconstruct their thinking.

Instruments: Process Data

Protocols were collected, transcribed, and initially parsed according to procedures outlined by Flower and Hayes (1980). The transcripts were read first for a general impression of the levels and types of detail and for a sense of the major reading and writing episodes (Ackerman, 1989c). In two process features, elaborations and rhetorical awareness, reading and writing were treated as distinct modes. This distinction was included to locate and qualify various processes across comprehension and composing, even though reading and writing are assumed to be simultaneous and interdependent. The transcripts were parsed into T-units (Hunt, 1965) with each unit judged for elaborations and rhetorical awareness, and task representations inferred from the entire protocol.

Elaborations

A T-unit was coded an elaboration only if it carried explicit, imported information that could not be traced to a source text. Once an elaboration was recognized in a T-unit, it was categorized according to two qualities, Reading vs. Writing Mode and Local vs. Global Abstractions; with mode and abstraction labeled, each elaboration was further judged for an Evaluative Function.

All elaborations were located in either episodes of comprehension or composing. Reading elaborations typically surrounded verbatim reading and were apparently cued by explicit items in the source texts. Writing elaborations frequently surrounded considerations of task, essay content, and rhetorical approach (elaborative information is underlined is these and following examples).

> During Reading: ... the large firms' research and development ... yeah, every large firm is gong to have a R & D section and a bunch of small firms aren't ...

> During Writing: ... I'm going to start with with an overall introduction before talking about supply-side economics ... why macro economics has failed ... and this is drawn from the thoughts of Sargent ... the idea is that businessmen are more sophisticated ...

All elaborations were also judged for the level of abstraction of the imported information. "Local" elaborations appeared as a specific association of a comparable concept, assumably the product of the writer's familiarity with either the general topic or an explicit or implicit claim by one of the assigned authorities. If an elaboration was not specific and the referent to the association was not obvious, it was labeled "Global." Global elaborations were more difficult to categorize with certainty but were closer in kind to free associations, where the connection between explicit text reference and the writer's associations was less tentative or speculative.

> Local Abstractions: ... the second article is on the ... effects of practice ... this I know something about ... that spaced practice leads to better retention than massed practice ... Well, this next section talks about ... Well, it's the primacy and recency effect sort of thing ...

> Global Abstractions: ... the focus here is on the massive lack of effective demand ... guess that means that people just weren't buying things ... in this next section ... I can begin to see why supply-side economics is becoming more important than in the past ...

A final quality distinction was whether elaborations fulfilled an evaluative function for the writer. Stein (1989) has demonstrated that prior knowledge is often used to judge the acceptability of an idea or account for its preference over others in composing. In this study, evaluation was assumed to be a key function in selecting and organizing relevant information for the essays.

> Evaluative Function (following reading): ... I'm not sure that's the answer ... because that just increases the observed economy ... without perhaps increasing the mid-sized economy ... all Brookes is saying is that most of the innovations is done by small business ... but there's a reason for that, they don't have to answer to shareholders ...

Rhetorical Awareness

In this analysis, "rhetorical" was taken to mean a writer's conscious observations, considerations, and decisions which appeared as an awareness of Structure, Context, and Content. As with elaborations, rhetorical awareness was first attributed to reading vs. writing modes. Awareness during reading was further categorized as being either structural or contextual, while awareness during writing included all three functions. Content awareness was excluded from reading because attention to explicit content is a given in reading comprehension, and it is not in constructing an essay.

When writers during a reading episode recognized structural features in a source text, they did so in an apparent attempt to reconstruct part of that author's chosen arrangement and style. These structural features appeared to take several forms, depending on whether the writer recognized conventional features or text features unique to a given source text. Conventional features, for example, could be sentence and paragraph boundaries, subsections, common modes of discourse (e.g., descriptions, histories, and examples), or sentence complexity. Idiosyncratic features might be an author's unique arrangement, use of evidence, metaphor, or style and diction. While reading the source texts, writers also appeared to reconstruct the rhetorical situation in which a text was written or the author's purpose and intended effect on an audience. Commonly, the latter came as the result of recognizing the quality of an argument or the use of evidence in a passage. The difference between rhetorical-structure and rhetorical-context in comprehension is that structural awareness is concerned with specific text features while contextual awareness is evidence of a writer placing a text in a larger frame of reference.

> Structural Awareness during Reading: *... we're looking at nitpicky details here ... now he's going to provide an explanation for his theory of economics ... well this first sentence is just an introduction to the idea ...*
>
> Contextual Awareness during Reading: *... this book or whatever it is written for freshman ... this guy has the most balanced viewpoint ... this stuff is pretty much flame-driven rather than real theory driven ...*

Rhetorical awareness of structure and context during writing were theoretically similar to those functions during reading. Writers concentrated on the arrangement of their essays and the rhetorical properties and style of their arguments. While composing their essays, writers considered structural features at the word, sentence, paragraph levels as well as rhetorical devices and the structure of evidence and argument. Choosing the arrangement of information in an essay was considered structural if the writer did not mention explicit content (otherwise categorized as awareness of content). Writers also on occasion commented on their intentions and plans for their essays. When writers contextualize their composing they do consider content and structure. However, these considerations are contextual when they are placed in a larger frame of reference and are seen as concern for the overall quality of an essay. Writers also at times showed awareness of audience and couched their composing decisions in terms of an intended reader. Because of the diversity of perspectives in the source text and the absence of explicit repetition of ideas (implying importance), and because the integration of prior academic learning or world experience was a challenge, the writers in this study often verbalized their decisions and considerations on what to include in their essays. Besides offering their rationale for selecting information, they made organizational decisions which appeared to be based primarily on the order of ideas suggested by content—either from the source texts or from their prior knowledge.

Structural Awareness during Writing: *... how can I make a general kind of opening statement? ... conclude with some caveats ... I've got to find a better word for this ...*

Contextual Awareness during Writing: *... it should be clear to the reader that this situation is easily explained by supply-side economics ... I'm going to limit my scope here ... I'm trying to understand this so I can summarize it in my essay ...*

Content Awareness during Writing: *... I could use the Newell and Simon stuff here ... this (passage) will have to be included in my essay early on ... that would mean cutting out a lot of the particular economic stuff ...*

Task Representation

The way writers represent a composing task may matter as much as their experience writing or their prior exposure to an assigned topic (Flower, 1987). Explicit comments in the transcripts, i.e., "This should be more than a lit review" or "The idea is to write an essay that brings all of this together" and an overall impression drawn from reading through an entire protocol transcript were the bases for three categories of task representation.

- A Text-based Representation was one in which the writer saw little or no value or opportunity to use her own ideas. The authorities provided in the source text were accepted prima facie.

- A Text + Writer Representation was one in which the writer still saw the task as mainly managing and organizing source text material with the writer's prior knowledge and experience used to substantiate or qualify the source texts but not override them.

- A Writer + Text Representation was one in which an essay originated with the writer's version of the topic and task and secondly with the ideas found in the source texts.

The protocol transcripts predictably evidenced far more cognitive activity than elaborations and rhetorical awareness, which accounted for 31% of the protocol T-units. For example, writers typically restated propositions from the source texts, formed gists, asked questions, or monitored their thinking processes (Flower & Hayes, 1981). Though not included in the analysis, restatements constituted the majority of T-units in the protocols, and predictably so since the subjects had to spend considerable time summarizing the newly-encountered readings.

Instruments: Written Products

The source texts and the graduate students' essays were analyzed using discourse analysis procedures sensitive to both micro and macrostructures (Meyer, 1985). At the microstructural level, texts were parsed into content units and then analyzed for their Importance (combined between and within-sentence height) and Origin (whether they originated from source texts or from prior knowledge). Content units were derived by parsing essays and source texts into clausal units, according to an extension of Kroll's (1977) "idea unit" demarcations (cf. Johns, 1985). At a macrostructural level, the essays

were analyzed for the presence of five Rhetorical Moves common to problem-solution discourse (Hoey, 1986).

Importance

Each clausal content unit in a source text or essay was judged and labeled according to its "importance" or relative height in the text's hierarchy of information, reproducing the staging or "relative prominence" (Clements, 1979) of main and supporting information in texts. Between-sentence relations represent the linear, sequential nature of written discourse, while the within-sentence relations represent the embedded nature of compound/complex sentences. The between-sentence relations were based on Nold and Davis's (1980) extension of the principles of "coordination" and "subordination" (cf. Christensen, 1965; D'Angelo, 1975) to include "superordinate" relations, or sentences which in effect return to a top-level position in the content structure. Nold and Davis offer a system for categorizing the linear relations between sentences by judging levels of abstraction and rhetorical operations, which required in this analysis additional rhetorical operations (indicated by an asterisk) to account for relations found in the source texts and essays (Table 2).

Table 2
Between-sentence Relations and Operations

Sentence Relations	Effect on Levels of Abstraction	Rhetorical Operations
Coordinate	Maintain	Conjoin, Restate, Contradict, Contrast New Idea of Equal Status*
Subordinate	Lower	Explain, Define, Exemplify State Conditions for Acceptance*
Superordinate	Raise	Generalize, Conclude State a Resulting Claim* Introduce a New Topic*

* rhetorical operations added to Nold and Davis

Height assignments began with the first sentence in the first paragraph (or subheading) of a passage at a level 3. Thereafter the equivalency, subordination, or superordination of the next sentence was judged by sentence relations and rhetorical operations. Passage titles and section headings were counted as Level 3 ideas (Brown & Yule, 1983). As shown in Table 3, the principles of coordination, subordination, and superordination carried over in the assignment of within-sentence height—with an important difference. Within-sentence clauses were not treated as sequential relations but rather as proximal relations, following the principle of central and secondary predication (cf. Tomlin, 1985). Assignments began by judging the main idea of a sentence, which may include more than one clausal unit (cf. Geisler, Kaufer, & Steinberg, 1985). The remaining content units are by definition subordinate and are placed at either a second and third level of subordination. While levels 3 and 2 account for most subordination in complex/compound sentences, a third level (1) was necessary to account for

"metadiscourse" or "nontopical material" (Lautamatti, 1978; Vande Kopple, 1985). The principle of superordinancy is not lost in this system. The operations of "new ideas" and "resulting idea" (superordinate operations in between-sentence heights) are subsumed by the principle of central predication.

Table 3
Within-sentence Relations, Operations, and Predictions

Levels	Clausal Relations	Principles Operations
3	Coordinate	Central Predication New Idea, Resulting Idea
2, 1	Subordinate	Secondary Predication(s) Define, Explain, Exemplify, Modify

To arrive at one importance ranking, between and within-sentence heights were combined. Below are the possible combinations of sentence and clause heights and the corresponding importance ratings. As shown in Table 4, between-sentence heights overlap so that the central predication in a subordinate sentence (2-3) is categorized as equally important as the secondary predication in a level 3 sentence (3-2). This system was devised after examining the occurrences of level 1 within-sentence height in a paragraph. Recalling the concept of metadiscourse, information at this level is not typically central to the logic of the paragraph and can relegated to a lower level of overall importance.

Table 4
Importance Ratings from Between and Within-sentence Heights

Importance from Combined Height	Between & Within Sentence Ratings		
5	3-3		
4	3-2	2-3	
3	3-1	2-2	1-3
2		2-1	1-2
1			1-1

Origin of Information

With importance assigned, content units in an essay text base (Appendix A) were categorized as having one of four origins. The judgment of origin was based on the most prominent information in a clause and on a range of information and research tools available to the researcher: the original passages, a macro-structural listing of passages ideas, the text bases, the summary of repeated ideas and themes, and the computer which allowed a search through as text base for specific lexical items. The four origins were

New, Borrowed-Explicit, Borrowed-Implicit, and Mixed (New & Borrowed or Explicit & Implicit) information

A template procedure was developed (Ackerman, 1989b; cf. Meyer, 1975; Spivey, 1983) to separate "new" information, judged to originate from the writer's prior knowledge, from "borrowed" information, traceable to one or more source texts. The decision then was whether a borrowed unit was based on explicit or implicit source text information. This distinction reflects what various reading researchers have noticed—that readers attend to both discrete elements in texts (defined syntactically and semantically) and to less definite themes, the semantic intent of the author (Collins, Brown, & Larkin, 1980). A unit was tagged "explicit" if the writer borrowed actual, lexical elements from a source text content unit or if the borrowing was a close paraphrase of an author's statement. The mixed category accounted for less than 2% of the content units in this study and was not analyzed further.

Rhetorical Moves

The analysis of rhetorical moves (Dudley-Evans, 1981; Swales, 1984) in this study draws upon Michael Hoey's (1986) work with problem-solution discourse. Five basic moves were considered: premise, context, particulars, evaluation, and conclusion. The Context and Evaluation moves were selected for analysis because they were assumed to correspond with the process features of rhetorical awareness of context and evaluative elaborations. Once the five patterns were located in an essay, context and evaluation were given a qualitative score for origin (new vs. borrowed) and strength (weak, moderate, or strong).

Reliability in the Process and Product Measures

Confidence in the various product and process measures was achieved by asking a second rater to follow the same coding procedures, working with a random sample of 20% of the process data (four protocols, one representing each of the four conditions) and 20% of the 40 essays. Since the judgment of importance was based on a grammatical system, confidence was achieved by giving the system to two trained linguists who successfully parsed sample passages from student essays. Cohen's kappa (1960) was used to compute rates of interrater agreement because of multiple categories in the process and product measures (Table 5).

Taking $k > .70$ as a standard, the high agreement between raters was partly attributed to the second rater's training and experience with process tracing research methodology. However, the category, rhetorical awareness in writing, was administered twice (first score in parentheses) because the second rater applied a different definition of "content" on the first effort.

Table 5
Interrater Reliability for Process and Product Measures

	kappa
Process Measures	
Other Behavior vs. Rhetorical Awareness & Elaborations	.87
Elaborations:	
Reading vs. Writing Mode	.87
Local vs. Global Abstraction	.71
Evaluative Function	1.00
Rhetorical Awareness:	
Reading vs. Writing Mode	.94
Reading: Structure vs. Context Function	.74
Writing: Structure vs. Context vs. Content Function	.63 (.36)
Task Representation	
Text vs. Text + Writer vs. Writer + Text	1.00
Product Measures	
Origin of Information	
New vs. Borrowed-Explicit vs. Borrowed-Implicit	.83
Rhetorical Moves	
Context & Evaluation	1.00
Strength	.87

Data Analysis

Four-way analysis of variance with two repeated measures was the primary statistical test for exploring the research questions on composing processes (elaborations and rhetorical awareness) and written products (importance and origin of information). For processes, mode and abstraction were the two within-subjects factors for elaborations, and mode and function for rhetorical awareness. For written products, importance and origin were the within-subjects factors with the Newman-Keuls test used for multiple comparisons. Chi-square tests were chosen for the categorical data in the task representation and rhetorical moves analyses. Interrelationships among process and product features were explored with a product-moment correlation matrix. To address a post hoc question of whether categories of task representation correspond with processes or products, the three representations were used as grouping variables, producing an unbalanced ANOVA with Scheffe's F test applied as a follow-up. Several additional analyses involved two-way analyses of variance: evaluative elaborations, awareness of content during writing, essay length, and time on task. Because of the theoretical and practical importance of the amount of time committed to solving complex problems (Anderson, 1983), time on task was also examined as a covariate with key process and product measures. The possible influence of the protocol condition was addressed by comparing protocol and non-protocol subjects for time on task, length, importance, and origin.

Results and Discussion

Comprehension and Composing Processes

A balanced subset of 20 subjects from all four conditions completed think-aloud protocols. Each T-unit coded an elaboration was also coded for mode (reading vs. writing)

and for abstraction (local vs. global). With these two subcategories assigned, each unit was further categorized as to whether it had an evaluative function or not. For rhetorical awareness, T-units were also coded for mode, and for the functions of structure and context. They were further coded for content if they had been classified into the writing mode. A writer's task representation was inferred from process data (protocol transcripts) and was categorized as being text-based, text + writer, or writer + text. Time on task, recorded in minutes, was the final process consideration, and it will be discussed later under "procedural and post hoc analyses."

Elaborations

Research on elaboration in reading supports a prediction that topic familiarity, from years of exposure to ideas in a disciplinary field, enabled the writers in this study to recall and verbalize associative information which aided comprehension and composing. Table 6 lists the means and standard deviations for each subcategory of elaboration across all four conditions. Although each elaborative T-unit was double-coded and sometimes, in the case of evaluation, triple-coded, the individual means for mode and abstraction are presented here, along with total elaborations (all codings collapsed into one) and evaluative elaborations as single categories.

Table 6
Means and Standard Deviations of Elaborations

Discipline:	Psychology		Business		
Topic:	Rehearsal	Supply-side Economics	Rehearsal	Supply-side Economics	Grand Mean
Elaboration Total	33.60 (21.34)	16.60 (12.05)	14.00 (9.30)	44.80 (39.23)	27.25
Mode - Reading	16.00 (8.78)	9.60 (5.90)	8.60 (6.31)	20.40 (16.21)	13.65
Mode - Writing	17.60 (13.52)	7.00 (8.46)	5.40 (4.62)	24.40 (24.18)	13.60
Abstraction - Local	26.40 (22.31)	0.00 (0.00)	3.80 (4.82)	39.60 (36.58)	17.50
Abstraction - Global	7.20 (8.41)	16.60 (12.05)	10.20 (9.42)	5.20 (4.44)	9.75
Evaluation	11.40 (12.10)	3.40 (2.41)	3.80 (4.15)	19.60 (17.21)	9.55

For the statistical analysis of elaboration, and for rhetorical awareness and other product measures, an interaction of the between-subjects factors in a four-way ANOVA compares high-knowledge and low-knowledge writers. As Table 7 illustrates, the interaction effect of discipline and topic was present for total elaborations and especially for local abstractions.

Table 7
ANOVA for Elaborations

Source	*df*	*MS*	*F*
Between Subjects			
Discipline	1	57.80	0.43
Topic	1	24.20	0.18
D X T	1	871.20	6.42*
Error	16	135.68	
Within Subjects - Mode (reading vs. writing)			
Main Effect	1	2.45	0.15
Discipline	1	6.05	0.36
Topic	1	0.05	0.00
D X T	1	61.25	3.64
Error	16	16.83	
Within Subjects - Abstraction (local vs. global)			
Main Effect	1	396.05	3.03
Discipline	1	130.05	1.00
Topic	1	31.25	0.24
D X T	1	1602.05	12.27**
Error	16	98.76	
Repeated Measures Interaction			
Mode X Abstraction	1	9.80	0.68
Discipline	1	7.20	0.50
Topic	1	20.00	1.40
D X T	1	1.80	0.13
Error	16	14.33	

* $p < .05$ ** $p < .005$

No significant results were found for discipline, topic, or for the main effects of mode and abstraction. When writers composed on a familiar topic, they not only elaborated more often, they produced more local elaborations. The comparative strengths of these findings can be understood by combining means from Table 6: high-knowledge writers, psychology and business majors writing on rehearsal and economics respectively, produced 78.4 "total" elaborations compared with 30.6 for low-knowledge writers. High-knowledge writers produced 66.0 local elaborations compared with 3.8. A comparison of means for global elaborations indicates a reciprocal relationship: high-knowledge writers drew fewer general associations between their memory and text and topical ideas than low-knowledge writers.

Of note, the grand means for mode indicate that elaborations, whether they are local, global, or evaluative, appeared consistently across comprehension and composing episodes (13.65 and 13.60 respectively). Although the definition of elaboration in this study was taken from reading research, where elaboration theory is used to account partially for idiosyncratic comprehending, associative thinking in this study appeared with equal frequency across reading and writing episodes. Good writers as readers appear to draw upon their prior knowledge both to comprehend, in this case a collection of challenging texts, and to search for relevant claims and details to include in their essays. Elaborations were also coded for an evaluative function, which arguably contributes not only to comprehension but to the selection of information for the essays. If an elaboration is evaluative, by definition it is evidence of writers choosing and excluding ideas according to preference or possibly to adhere to a rhetorical purpose. Two-way ANOVA revealed a similar pattern of appearance for evaluative elaborations: high-knowledge writers produced

more evaluations, F (1/16) = 6.08, p < .05, while the factors of discipline and topic separately did not influence their presence (Appendix B).

Rhetorical Awareness

We might predict that prior knowledge of a disciplinary topic may help writers to be more rhetorically aware through the reading and writing of synthesis essays. After all, if the subject matter is familiar, writers may spend less time "parsing" the assigned source texts to find the "gist" and, correspondingly, may be able to invest more conscious attention to the rhetorical concerns of structure, rhetorical context, or the content of an essay. Table 8 presents the two within-subjects factors of mode and function (structure and context), total rhetorical awareness, and awareness of content during writing.

Table 8
Means and Standard Deviations of Rhetorical Awareness

Discipline:	Psychology		Business		
Topic:	Rehearsal	Supply-side Economics	Rehearsal	Supply-side Economics	Grand Mean
Total Awareness	62.60 (17.20)	66.60 (29.31)	31.60 (15.73)	56.20 (17.58)	54.25
Mode - Reading	9.20 (4.76)	25.00 (3.94)	10.20 (7.79)	18.80 (3.27)	15.80
Mode - Writing	53.40 (14.29)	41.60 (26.58)	21.40 (11.61)	37.40 (17.33)	38.45
Function - Structure	19.40 (3.36)	28.60 (13.96)	15.20 (6.98)	20.80 (12.32)	21.00
Function - Context	15.80 (6.61)	19.80 (12.64)	6.40 (6.19)	23.40 (6.03)	16.35
Write-Content	27.40 (9.24)	18.20 (20.73)	10.00 (5.66)	12.00 (6.36)	16.90

Table 9 illustrates the different roles prior knowledge of a topic may have played in contributing to rhetorical awareness compared with elaborations. Whereas the interaction of discipline and topic led to more elaborations generally, rhetorical awareness was far more sensitive to individual disciplines and topics. Also, whereas elaborations appeared equally in reading and writing modes, rhetorical awareness was more sensitive to mode and to the functions of structure and context. In other words, though elaborative processes appear to be driven by prior knowledge, rhetorical awareness is more sensitive to the other factors in this study, with the notable exception of awareness of context. Contextual awareness was the only subcategory of rhetorical awareness which appears to be influenced by a writer's topic knowledge.

Table 9
ANOVA for Rhetorical Awareness

Source	*df*	*MS*	*F*
Between Subjects			
Discipline	1	1095.20	4.49*
Topic	1	1296.05	5.32*
D X T	1	281.25	1.15
Error	16	243.86	
Within Subjects - Mode (reading vs. writing)			
Main Effect	1	1428.05	38.89***
Discipline	1	174.05	4.74*
Topic	1	16.20	0.44
D X T	1	39.20	1.07
Error	16	36.72	
Within Subjects - Function (structure vs. context)			
Main Effect	1	1620.00	20.73***
Discipline	1	192.20	2.46
Topic	1	61.25	0.78
D X T	1	832.05	10.65**
Error	16	78.16	
Repeated Measures Interaction			
Mode x Function	1	3726.45	21.15***
Discipline	1	432.45	2.45
Topic	1	217.80	1.24
D X T	1	105.80	0.60
Error	16	176.22	

* $p < .05$ ** $p < .005$ *** $p < .001$

For the subjects completing this task, the assumed similarity between psychology and business disciplines did not hold, at least for the factors examined in rhetorical awareness. The psychology graduate students were generally more rhetorically aware, evidenced by the main effect for discipline in the between-subjects comparisons. A summing of means from Table 8 reveals that, for total rhetorical awareness, the psychology students produced 129.2 T-units compared with 87.8 for the business students. The discipline of psychology also significantly interacted with mode, and psychology students were more rhetorically aware through the writing episodes (95 vs. 58.8) and were found to more frequently comment on content during writing, $F\ (1/16) = 4.74, p < .05$ (Appendix B). These disciplinary differences and the higher performance of psychology students may be explained partially by the exposure of psychology students to protocol procedures and experimental testing. It would be hasty to conclude that psychology graduates at Carnegie Mellon and the University of Pittsburgh are generally more rhetorically aware than their peers in business, although these findings clearly suggest that rhetorical awareness in writing was a more comfortable or desirable activity for these students.

Rhetorical awareness was also topic-sensitive in ways elaboration was not. A main effect of topic in the between-subjects comparisons revealed that supply-side economics invited more rhetorical awareness across groups of students and across functions (122.8 T-units compared with 94.2 for the topic of rehearsal). Though care was taken to choose topics with equal status in their respective fields and with relatively similar styles of presentation, supply-side economics apparently was the preferable subject matter. The topic may have had a more popular flavor, given the recency of economic policy debates in the news media. This added familiarity and contemporaneity, in turn, may have made it

easier for writers to construct a rhetorical situation, with corresponding issues for support and debate, and may also have opened the passages up for structural analysis. Considering passage characteristics, the supply-side economics collection was not necessarily less technical, less discipline-specific, or more anecdotal, and these passages were not necessarily easier to read, if we accept the ratio of syllables to sentences as an indicator of complexity. If writers found a topic accessible and more rhetorically flexible, they possibly did so because their task representation supported that interpretation.

Two other main effects and two interactions are noteworthy in the four-way ANOVA. Both main effects for mode and function were strongly significant ($p < .001$). Again turning to the means in Table 8, we can see why. Rhetorical awareness appeared more often in writing episodes (153.8 vs. 63.2 T-units) and consisted mostly of structural comments (84.0 vs. 65.4). The trend to comment on discourse structures and conventions, especially while composing, changed when the factors of discipline and topic were introduced. High-knowledge writers were significantly more aware of context, producing 39.2 comments coded as context compared with low-knowledge writers who produced 26.2 comments ($p < .005$). In summary, for the writers in this study, rhetorical awareness largely consisted of sensitivity to discourse structures and conventions, although the main effect for function should not be construed as "more is better." Considering the possible impact each function could have on an emerging text, awareness of structure may be cumulative: a writer may make a series of comments about discourse features and conventions, with regard to source texts and to her own essay, during the course of comprehension and composing. In contrast, even one or two hypothesized rhetorical situations may completely redirect a composition because rhetorical awareness of context may trigger a writer's reassessment of audience, purpose, content, or style (Flower, 1987).

These findings appear to confirm predictions about the influence of prior topic knowledge made by Haas and Flower (1988), who termed "rhetorical reading" as a reader's ability to hypothesize or reconstruct a larger frame of reference. Apart from the influence of discipline (psychology) and topic (supply-side economics), awareness of context was the only form of rhetorical sensitivity which responded to a writer's prior knowledge. However, awareness of context was not noticeably more present during the comprehension portion of the protocol transcripts. Contextual awareness during writing appeared only slightly more often than contextual awareness during reading (8.6 vs. 7.8 T-units). Rhetorical reading may be a special faculty which bridges comprehension and composing and may be especially well-suited to do so. Other forms of rhetorical awareness, structure and content during writing, perhaps illustrate rhetorical skills in reading and writing which are less sensitive to prior knowledge of a topic. Certainly these findings draw attention to the varied functions of contextual and structural awareness, and these findings generally correspond with earlier research on expertise in composing (e.g., McCutchen, 1986) which distinguished knowledge of subject from knowledge of discourse.

Task Representation

The classifications of task representation were inferred from reading an entire protocol transcript which included fragments of the essay drafts. In the contingency table below (Table 10), two categories of writers, high and low knowledge, were crossed with the three categories of task representation. The task representation data were categorical and the chi-square tests required collapsing four conditions into two: psychology and business students composing on a familiar disciplinary topic were categorized as high knowledge, and students in both disciplines composing on an unfamiliar topic were categorized low knowledge.

Table 10
Observed Frequencies of Three Task Representations for Two (collapsed) Conditions

	High Knowledge	Low Knowledge	Total
Text-based	0	7	7
Text + Writer	6	3	9
Writer + Text	4	0	4

The chi-square analysis revealed significantly different frequencies of the three task representations for the two groups, high knowledge and low knowledge, X^2 (2) = 12.0, p < .005; however, probability is suspicious due to low or empty cell values (Huck, Cormier, & Bounds, 1974; cf. Conover, 1980). The contingency table illustrates the relative trend for low-knowledge writers to rely on source texts to complete their synthesis assignment. All of the seven "text-based" representations were found in the transcripts of low-knowledge writers. And conversely, these trends support the prediction that topic familiarity will lead (but does not guarantee) writers to be more inventive in how they construe an open-ended, synthesis writing task. The four "writer + text" representations were high-knowledge writers.

Written Products

Analyses of written products were conducted for all 40 graduate students from psychology and business since every subject produced an essay. The features chosen for analysis were importance or prominence of ideas in an essay's organization, origin of information (new vs. borrowed ideas), and the quality of rhetorical moves. Length does not necessarily equate with quality; yet essay length could partially account for differences in how writers selected and placed content units. The writers in this study, however, did not significantly differ in the length of their essays, averaging 63.48 content units, F (1,36) = 1.11, $p > .20$ (Appendix B). The only condition which deviated much from the grand mean was business majors writing outside their discipline on the topic of rehearsal in memory, producing on the average 52 content units per essay.

Importance

Importance of an idea was defined by a composite score for where a content unit resided in intra-sentence and intra-paragraph embeddings. Five levels were used for this analysis, corresponding generally with opening claims (level 5), supporting sentences and clauses for those main claims (levels 4 and 3) and extended detail or meta-discourse (levels 2 and 1). Table 11 and Figure 1 list and illustrate the number of content units judged to be located at a given level in a synthesis essay organization for the four conditions.

Table 11
Means and Standard Deviations of Five Levels of Importance for Four Conditions

Discipline:	Psychology		Business		
Topic:	Rehearsal	Supply-side Economics	Rehearsal	Supply-side Economics	Grand Mean
Level 5	18.10 (9.17)	19.10 (5.88)	13.20 (6.02)	22.20 (8.48)	18.15
Level 4	25.20 (11.57)	20.60 (6.77)	16.20 (8.70)	25.70 (14.58)	21.93
Level 3	18.40 (8.14)	16.70 (10.21)	13.20 (6.56)	15.00 (10.49)	15.83
Level 2	6.00 (2.63)	5.50 (3.63)	4.20 (2.62)	4.10 (3.67)	4.95
Level 1	0.80 (0.79)	0.50 (0.71)	1.30 (1.83)	0.20 (0.42)	0.70

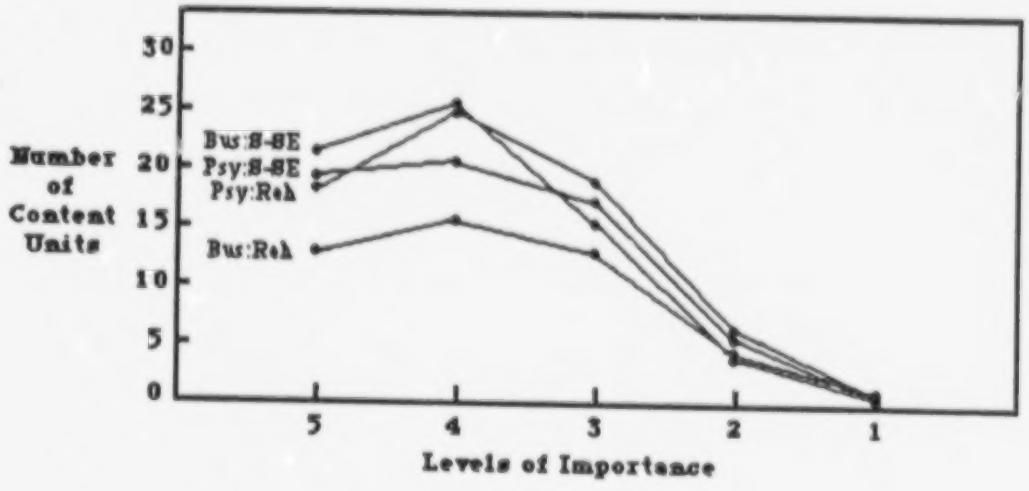

Figure 1. Importance levels for writers in four conditions.

Across all four conditions, writers placed most of their information in the top three levels. Though no standard for prominence of each of the five levels was established in this study, this trend may indicate relatively brief sentence and paragraph structure without extended elaboration or detail. This would not be too surprising given that the writers produced what was essentially a revised first draft, based primarily on claims and assertions and less on warrants, extended examples, or supportive detail. The relative absence of lower level information also suggests that the writers did not include the meta-discourse which is probably more common to published documents. The line graph especially illustrates that writers who composed on a familiar disciplinary topic were able to place more information at the upper reaches of their essays (note level 4); they were probably able to advance more claims and more elaborate claims. Level 4 was defined as a supporting clause within a top-level sentence and as a supporting sentence in a paragraph.

Origin of Information

The origin of ideas in the synthesis essays was determined by attributing essay content units to either new or borrowed information and by further distinguishing borrowed information as either explicit or implicit, leaving essentially three kinds of information in the essays (New, Borrowed-Explicit, Borrowed-Implicit). Table 12 lists the means and standard deviations of origin for the four conditions. To help clarify how the three kinds of information in their essays were used by writers and generally how a writer's prior knowledge of an academic topic influenced the selection of ideas, consider Figure 2, a bar graph based on mean scores for three kinds of information. For the sake of comparison, the four conditions (discipline x topic) were collapsed into two conditions: high and low prior knowledge of a topic in a disciplinary domain.

Table 12
Means and Standard Deviations of Origin of Information for Four Conditions

Discipline:	Psychology		Business		
Topic:	Rehearsal	Supply-side Economics	Rehearsal	Supply-side Economics	Grand Mean
New	24.00 (20.37)	17.90 (19.89)	7.50 (7.79)	36.40 (24.74)	21.45
Borrowed-Explicit	10.10 (7.78)	17.20 (9.67)	14.00 (6.77)	7.10 (7.53)	12.10
Borrowed-Implicit	32.70 (11.19)	30.50 (12.60)	29.00 (18.24)	27.50 (13.49)	29.93

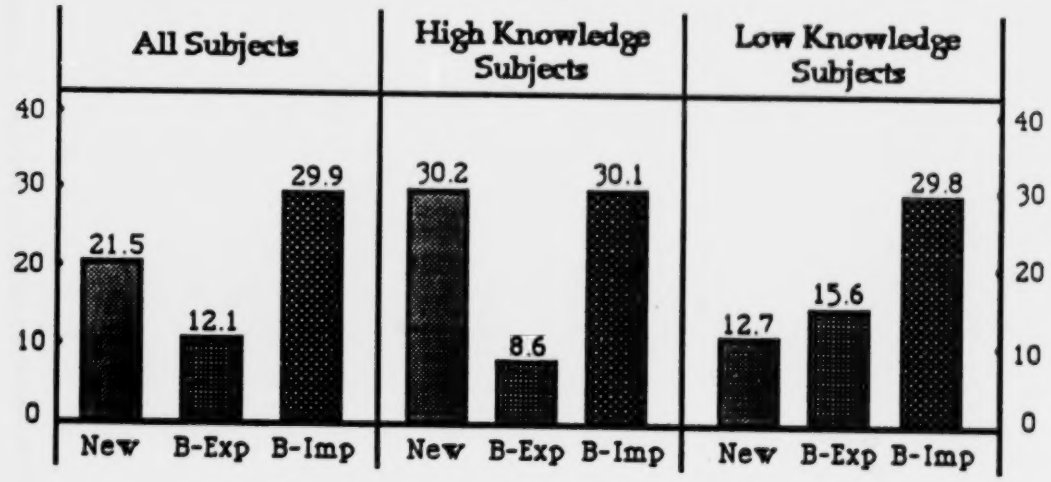

Figure 2. The number of content units for new and borrowed ideas.

Figure 2 indicates the relative dependency of all 40 writers on the three classes of information. For synthesis writing assignments, we might expect accomplished writers (such as the ones in this study) and novice writers alike to rely on source texts, since those texts represent an explicit authority on an assigned topic (cf. Hidi & Anderson, 1986). Here, and as the left-hand cell indicates, 66% of the information (explicit and implicit) came from the sources texts (12.1 + 29.9 + 64, the average essay length). Though this study did not compare expert and novice writers, the relatively low reliance on explicit information (mean of 12.1 vs. 29.9 for implicit) suggests that the experienced writers in this study not only read for implicit themes and key ideas but were able to integrate those themes into their essays. Thus, the assumption that writers in graduate school are expert readers seems to hold true, if expert reading is the ability to form top-level gists from complex material and apply those gists to a synthesis essay. Further evidence of the graduate students' expertise is evident in the healthy use of imported (new) information in their essays (33%: 21.5 + 64). Though Stein (1989) found that few elaborations transferred to student drafts, many of the writers in this study were able to use prior knowledge explicitly in their essays. Prior knowledge was not defined the same for process and products; although it is plausible that elaborations during reading and composing might translate into "new" information in an essay.

Subjects did not use new information equally, however, and as the bar graph illustrates, knowledge of a topic seems to account for those differences. As we see in the second and third cells, high-knowledge writers placed over twice as much new information in their essays and relied less on explicit, text-based ideas. In addition, the large amount of implicit, text-based information found in the essays holds constant for both groups. The nearly identical amount of borrowed-implicit information suggests again that the subjects in this study were expert readers and that their reading ability transcends relative familiarity with an academic topic (cf. Kieras, 1985). These data are fairly strong evidence for a domain-general reading ability to draw inferences by recognizing and utilizing the top-level

topical structure in texts. To examine how the between-subjects factors of discipline and topic and the within-subjects factors of importance and origin influence each other, a four-way ANOVA was run with importance and origin serving as the within-subjects factors. As with previous statistical analyses on process measures, the interaction of discipline and topic indicates performance differences between high and low-knowledge writers.

Table 13
ANOVA for Origin and Importance of Information

Source	*df*	*MS*	*F*
Between Subjects			
Discipline	1	41.08	0.89
Topic	1	24.40	0.53
D X T	1	85.88	1.86
Error	36	46.08	
Within Subjects - Importance (Levels 5 -> 1)			
Main Effect	4	1099.30	108.61**
Discipline	4	6.40	0.63
Topic	4	13.81	1.37
D X T	4	29.00	2.87*
Error	144	78.16	
Within Subjects - Origin (New/Bor-Exp/Bor-Imp)			
Main Effect	2	501.32	14.06**
Discipline	2	5.82	0.16
Topic	2	81.13	2.28
D X T	2	354.55	9.94**
Error	72	35.67	
Repeated Measures Interaction			
Origin x Importance	8	71.74	9.30**
Discipline	8	3.80	0.49
Topic	8	17.45	2.26*
D X T	8	37.88	4.91**
Error	288	7.71	

* $p < .05$ ** $p < .001$

The statistical tests produced highly significant main effects for importance and origin and for their interaction ($p < .001$ for all three). To determine which of the differences between means was significant, the Newman-Keuls post-hoc test was used at the .05 level of confidence. For importance, the means for levels 5, 4, and 3 were significantly greater than for levels 2 and 1, and level 4 was significantly greater than level 3. The line graph in Figure 1 illustrates the amount of information concentrated in the top three levels and the prominence of level 4 information. For origin, the post-hoc test revealed that the means for all three kinds of information significantly differed (recall Figure 2). To understand the main effect interaction of importance and origin, Figure 3 presents a line graph plotting the three types of information at each level of importance. This graph numerically and proximally relates importance to origin, with "number of content units" on the vertical axis indicating the average number of units across conditions at each level of importance. As Figure 3 illustrates, the three types of information were lodged primarily in levels 4, 5, and 3 respectively.

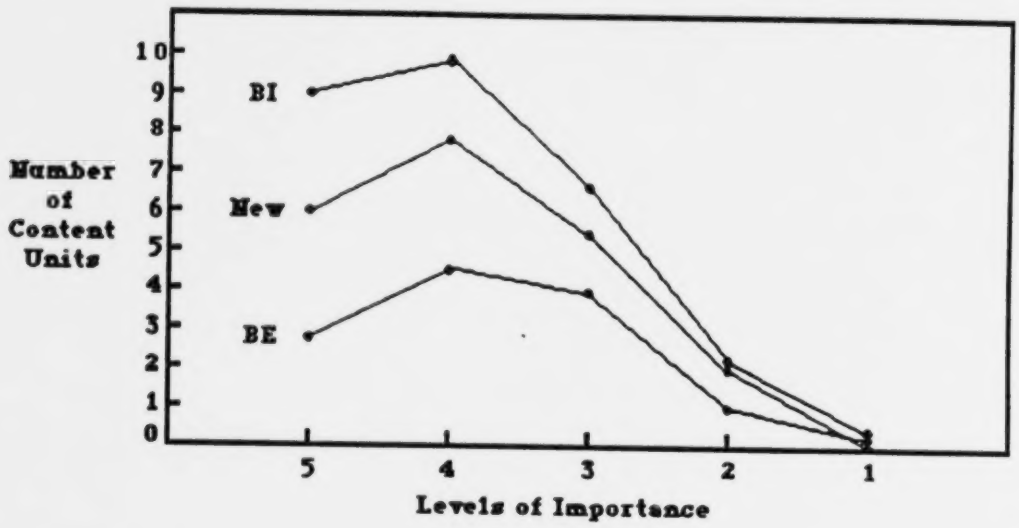

Figure 3. Content Unit Means: Importance for New and Borrowed Information.

This analysis, of course, does not reflect the influence of discipline and topic. Returning to Table 13, there were significant interactions between discipline, topic, and the two within-subjects factors, indicating that prior knowledge affected the selection and placement of information. The Newman-Keuls test revealed that high-knowledge writers placed more information in level 4 than low-knowledge writers (25.5 vs. 18.4 content units) and included more new information (60.4 vs. 25.4 content units) and less borrowed-explicit information (17.2 vs. 60.2) than low-knowledge writers. Thus, a conservative interpretation of the complex four-way interaction of discipline, topic, importance, and origin is that prior knowledge of a disciplinary-based academic topic helped writers to place significantly more new information in levels 4 and 5 respectively.

The added presence of new information at levels 4 and 5 suggests that the quality of the major claims, for example, in opening paragraphs or summary statements, vary in substance and depth from those writers who included less new information. The introduction of a major claim may be more involved in that a level 4 content unit may either be a major idea in a complex multi-clause sentence (between-sentence 3 and within-sentence 2) or a simple sentence functioning as support for a major claim (between-sentence 2 and within-sentence 3). The four-way ANOVA for product features also revealed a topic effect. Supply-side economics reappeared as the more inviting subject for placing new information in the top three levels ($p < .05$).

Rhetorical Moves

An analysis of rhetorical moves was undertaken to explore key features of problem-solution discourse, contextualizing claims and evaluating them, and to benefit from a reader's assessment of the overall quality of the synthesis essays. Similar to the analysis of

task representation, chi-square tests were used to examine difference in performance of high and low-knowledge writers with the rhetorical moves of contextualizing and evaluating. Both moves were classified according to origin of information and for the comparative strength.

Table 14
Observed Frequencies of Rhetorical Moves and Strength for High and Low-knowledge Writers

	Context			Evaluation		
Origin	**High Knowledge**	**Low Knowledge**	**Total**	**High Knowledge**	**Low Knowledge**	**Total**
Borrowed	14	17	31	9	13	22
New	5	1	6	6	3	9
No Rhet. Move	1	2	3	5	4	9
Strength						
High	9	11	20	7	7	14
Moderate	6	7	13	5	7	12
Low	4	0	4	3	2	5
No Rhet. Move	1	2	3	5	4	9

As the contingency tables illustrate and as chi-square tests revealed, there were no significant differences in the frequencies of either rhetorical move for origin or strength. High-knowledge writers were judged to rely more on new information in both context-building and evaluative moves, but the overall presence of new information which supported a rhetorical move was not nearly as prominent as in the analysis of origin where significant differences between new and borrowed information were found. Thus, there was a remarkable difference between the microstructural analyses of origin and the macrostructural analysis of new information as a quality of whole-text rhetorical moves. Even though a writer may place new information throughout an essay, implying originality, that information did not necessarily translate into more original rhetorical moves, according to a reader's judgement, and knowledge of a disciplinary topic did not appear to influence the relative strength of either move.

Several explanations seems plausible for a strong knowledge effect in one analysis and not in another. First, the commensurability of instruments may have varied more than was expected: the presence of content units, as a unit of measurement, may not transfer to a rhetorical/linguistic parsing of problem solution texts. Second, the scoring procedure for rhetorical moves, based on general impression categories, may gloss over differences in origin which appeared in the content-unit analysis. Perhaps an even more intriguing explanation is to suggest more broadly that quantitative differences in essays will not routinely correspond with qualitative judgments because the latter gives fuller rein to a reader's interpretive processes.

Interrelationships among Process and Product Measures

The analyses addressing the primary research questions, in part, were based on the general research hypothesis that prior knowledge, defined as familiarity with a disciplinary-based topic, would be manifested in comprehension and composing. Although a major aim of the study was to examine knowledge as an effect, the process and product features were

also chosen because they may theoretically relate to each other. Table 15 presents a correlation matrix for measures across all subjects and with significance levels noted. Mode and abstraction as subcategories of elaboration were dropped from the matrix to simplify the analysis and because neither correlated highly. Because most of the text information resides in the top three levels of importance, only they were included. A significance level of .10 was accepted in this analysis because of its hypothesis-generating nature.

Table 15
Intercorrelations among Process and Product Measures (N = 20)

	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. Time	.21	.04	.23	.04	.34	-.06	.07	.27	.30	.16	-.10	.36	.28	.32
2. RA Total		.52*	.94**	.76**	.48**	.14	.18	.33	.06	.15	.33	.26	.25	.32
3. RA Read			.20	.56**	.54**	.15	.10	.16	.35	.02	.14	.19	-.05	-.18
4. RA Write				.65**	.34	.10	.16	.35	.02	.14	.42*	.22	.30	.44*
5. RA Structure					.06	-.11	-.08	.09	-.24	.25	.29	.12	-.06	-.04
6. RA Context						.31	.39*	.13	.39*	-.10	-.18	.30	.22	.09
7. Elaboration Total							.75**	.05	.59**	-.69**	-.33	-.03	.11	.02
8. Elaboration Evaluation								.22	.76**	-.51**	-.37	.10	.26	.23
9. Length									.52**	.54**	.49**	.73**	.85**	.87**
10. Origin - New										-.24	-.41*	.48*	.53**	.44*
11. Origin - Borrowed-Explicit											.56**	.43*	.38	.37
12. Origin - Borrowed-Implicit												.23	.37	.50*
13. Importance - Level 5													.72**	.47*
14. Importance - Level 4														.74**
15. Importance - Level 3														

* $p < .10$ (two-tailed test) ** $p < .05$ (two-tailed test)

Several clusters of features are noteworthy. First, obvious intercorrelations are the various category sub-groups. We expect forms of rhetorical awareness, elaboration, origin, and importance to correlate positively or negatively with themselves. Also, origin and importance by definition should correlate strongly with length since they are sensitive to the number of content units in their subcategories, and these correlations appear in the matrix. And by the same reasoning, origin should correlate positively with levels of importance. Other patterns are less obvious. Time on task did not correlate with any of the process and product variables at a significant level. The only rhetorical awareness feature to correlate to any significant degree with elaborations or evaluative elaborations was awareness of context, and rhetorical awareness during writing correlated with borrowed-implicit information and level 4 ideas. Elaborations, as one might expect, correlated with new information in the essays and negatively with borrowed-explicit ideas—although we still cannot say that associative thinking found in protocol transcripts transferred directly to the construction of a synthesis essay. And, the significant correlations of origin with importance correspond with findings from the analyses of variance.

Rhetorical awareness of context correlated highly and positively with elaborations in the composing process, and especially evaluative elaborations, and with new information in the resulting essays. Those three features also surfaced from the range of process and product features as being especially sensitive to a writer's prior knowledge. The following diagram (Figure 4) illustrates these interrelations, with positive correlations with rhetorical

awareness of context presented in the top half of the figure and negative correlations with elaborations and new information presented in the bottom half.

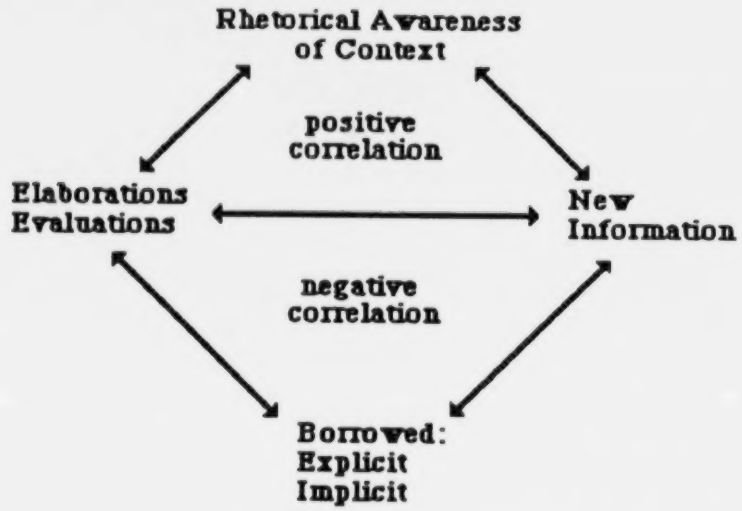

Figure 4. Correlations among key process and product features.

The three-way positive correlation between awareness of context, elaboration, and new information suggests a possible process and product dynamic in comprehension and composing. For complex tasks, perhaps the ability to cast a topic and task into a larger frame of reference (Durst, 1987) accompanies associative thinking as a writer studies a topic and assigned texts, and we may think of the functions of evaluating and contextualizing ideas as co-supportive. Together, elaborations and contextual awareness seem to promote the presence of new information in the drafts, information related to the process behavior. Figure 4 also depicts negative relationships between elaboration and borrowed information and between new and borrowed information. As we have seen in other analyses (origin, importance), and as the matrix suggests, borrowed-explicit information appears to be inversely proportional to the presence of new information, and it would follow with elaborations as well. Thus, as a writer is able to call up new ideas through comprehension and composing, there is a corresponding lessening of a need or reliance on explicit, text-based ideas.

Procedural and Post Hoc Analyses

Task representation, time on task, and the protocol condition itself were analyzed to see whether they influenced how students completed the synthesis task and whether they possibly confounded other analyses. A prediction based on research in task representation was that a writer's representation of the synthesis task would, in effect, guide comprehension and composing as much as discipline, topic, or their interaction. ANOVA revealed significant differences for total elaborations, $F\ (2,17) = 3.91$, $p < .05$; for

evaluative elaborations, F (2,17) = 6.26, p < .01; for length, F (2,17) = 4.18, p < .05; and for new information, F (2,17) = 62.05, p < .001. Scheffe's F test revealed that the writer + text representation accounted for differences among means (Appendix B). These findings raise the possibility that certain idea-based process and product phenomena, such as elaborations and including new information in an essay, are related to how someone addresses the assignment as much as to prior knowledge of topic.

It is important to know if time varied across conditions and if time covaries with either process or product features. The graduate students in this study, composing on both topics, took approximately the same amount of time to complete the synthesis assignment, averaging 131 minutes; there was not a significant effect for discipline or topic or an interaction between the two, F (1,38) < 1.0 (Appendix B), although the business students writing on "rehearsal" spent the least time (120 minutes) and the psychology students writing on "supply-side economics" the most (137 minutes). Analyses of covariance was run on total elaborations and rhetorical awareness, awareness of context, length, new information, and levels of importance 4 and 5 (Appendix B). These features were chosen because they represent the major process and product features and because they correlated more highly with time in the correlation matrix (Table 15). With the assumption of "common slope" established, time did not significantly covary with any of the process or product variables tested at a probability level of .05. Only length approached significance, F (1/37) = 3.81, p = .06. In terms of the other comprehension and composing features, time on task did not appear to be a major influence.

To determine how intrusive or facilitative the protocol condition may have been (thinking aloud may have helped some writers), ANOVA was run for the process measure of time and for the product measures of length, origin, and importance (Appendix B). For time on task no significant difference was found (F (1,38) < 1.0), and interestingly the think-aloud students took 10 minutes less to complete the task (126 vs. 136). The protocol condition also did not significantly affect length, F (1,38) = 1.61, or the other product features of origin (the kinds of information) and importance (levels 5 and 4). Although the reputation of intrusiveness in protocol methodology seems to be discounted here, thinking aloud may have detracted somewhat from the inclusion of new information, the one process or product feature which approached significance, F (1,38) = 2.37, p = .13.

Conclusions and Implications

The guiding hypothesis in this study was that writers with disciplinary knowledge, high-knowledge writers, would comprehend and compose differently as they completed a synthesis writing task. Generally, findings support this hypothesis: high-knowledge writers elaborated more often and their associations were more specific and evaluative (cf. McCutchen, 1986). They were also able to recreate verbally more rhetorical contexts across reading and writing episodes, and their final products carried more new information and placed new and borrowed-implicit ideas prominently in their essay organizations. Therefore, the significant effects attributed to prior knowledge confirm the view that reading and writing are constructive, coordinated processes. However, for these writers and this discourse synthesis task, familiarity with disciplinary topics did not override certain rhetorical concerns or account for all product differences. The fact that prior disciplinary knowledge did not account for all differences in reading and writing behavior reinforces other important assumptions underlying this research. Rhetorical and composing knowledge and skill, as well as how a task was represented, were assumed to guide composing as much as subject-area expertise.

To begin with, individual disciplines and topics, though assumed to be comparable, had some effect on performance. Graduate students in psychology were more rhetorically sensitive throughout comprehension and composing and especially during writing episodes. These students were not only structurally and contextually aware, they more often consciously selected content to include in their essays. Although a number of theorists and researchers acknowledge differences in the assumptions, forums, and habits of mind which demarcate disciplines (e.g., Herrington, 1985; Kinneavy, 1983), the disciplinary differences found in this study should be considered with caution. This study used disciplinary membership as a proxy for possessing high knowledge of an academic topic and was not designed to explore and clarify cognitive and social characteristics of disciplines. At best, the disciplinary differences serve as a springboard for more descriptive accounts of the rhetorical preferences and composing processes of members of various specialties inside and outside the university. Across disciplines, supply-side economics elicited more rhetorical awareness when structure and context were considered together, and it accounted for differences in the interaction of importance and origin of essay content units. The currency of supply-side economics as a public or common topic may partially account for its accessibility, but it would be faulty to conclude that the business topic was easier to synthesize across all categories of features. Supply-side economics as a topic was not a significant factor in elaborations or for the individual analyses of rhetorical functions and origin and importance of information.

In the statistical tests, topics and disciplines interacted to compare writers with varied levels and qualities of prior knowledge on an academic topic. Findings indicate that low-knowledge writers were not incapacitated by their relative unfamiliarity with a given topic. Elaborations were present throughout comprehension and composing, and their "global" elaborations, though perhaps not as easily translatable to essay claims and evidence, did contribute to the process of synthesizing ideas. Low-knowledge writers also evidenced equal amounts of structural and content awareness as high-knowledge writers and demonstrated their reading expertise by including nearly identical amounts of borrowed-implicit information in their essays. While low-knowledge writers did appear generally to be more text dependent, in their representations and in their essays, they also illustrated constructive reading and writing processes. A claim that the presence or absence of prior knowledge accounts for performance differences or success with a synthesis task ignores other important findings and misconstrues the varied forms and roles of prior knowledge in comprehension and composing.

Irrespective of topics and disciplines, all 40 writers completing a synthesis task evidenced evaluative elaborations, rhetorical awareness of context, and new information in essays, and these three features of comprehension and composing appeared to be interrelated and buttressed by prior knowledge. Positive correlations among these features suggest that writers with or without disciplinary-based knowledge may use associative thinking and rhetorically-based context building to support the inclusion of new information in their essays. Findings from analysis of variance suggest that extra disciplinary prior knowledge can only help, and considering the function of evaluation and context for writers, exposure to a disciplinary field apparently provides much more than a storehouse of topically relevant ideas, coherent and relevant arguments, or savvy rhetorical and linguistic ploys. Rather, prior knowledge in this study took the form of purposeful cognitive operations. The two process features delayed closure in comprehension and composing by providing a filter for negotiating familiar and less familiar information in the construction of a synthesis essay. Prior knowledge did account for the frequency of evaluative elaborations and rhetorical awareness of context, but the value of these process features lies in how they illustrate a conversational quality of writers integrating their experience and learning with published information. Prior knowledge was a purposeful activity for writers, not simply an asset. Prior knowledge appeared as rhetorical tools for

negotiating an intertextual network and not simply, as theories of content-based literate performance imply (Hirsch, 1987; cf. Voss, Greene, Post, & Penner, 1983), the major premise behind expert performance.

If prior knowledge was purposefully applied to synthesis tasks for rhetorical ends, then the goal to write may function as a unique perspective in making meaning (cf. McGinley & Tierney, 1989). Perhaps there are two kinds of perspectives for writerly readers to consider. First, as Pichert & Anderson (1977) and other reading researchers have argued, a reader's beliefs and orientation to a topic affect comprehension—knowledge alone, in the bald sense of prior familiarity with a topic, is not the only factor. Therefore, when writers compose syntheses of information from multiple texts, a perspective on the topic might influence the selection and evaluation of content as well as the construction of an organizing frame for an essay. However, even belief systems are sometimes subordinated to the pragmatics and rhetorical purposes in composing written documents. A perspective on a topic is not by definition secondary to the goal to write; yet the problem of constructing coherent sentences to meet the expectations of tasks and readers may pose a significant threshold for writers who read from sources. From this data analysis, certain kinds of rhetorical awareness transcended topic familiarity, and task representations may provide alternative lenses for understanding why some writers feature new information in their essays while others do not. For reading in the act of writing, constructivism begins with a writer's intention to compose, and this pragmatic, rhetorical perspective evolves throughout comprehension and composing (cf. Flower, Stein, Ackerman, McCormick, Kantz, & Peck, in press).

The problem of constructing coherent sentences to meet a reader's expectations and a writer's intentions may partly explain why "originality" was apparent in the microstructural analyses, in the form of new content units at levels 4 and 5, but did not transfer to whole-text rhetorical moves. Whereas the disappearance of originality may be explained by an inequity between macro and microstructural instruments, the dissimilarity between process and product features (cf. Durst, 1987) may be evidence of an important juncture in comprehension and composing. Even though a writer may know her subject matter well, and may be able to think rhetorically and associatively, and read for gists and seek to incorporate her own ideas in an essay—as a writer facing a blank page, she may have trouble translating composing and intentions into reader-based text. The translation of a reading plan into a writing plan, and a writing plan into continuous, coherent text is far from automatic or obvious for even the best writers (cf. Ackerman, 1989c). One reason may be that the conventions of specialized prose often complicate the application of original ideas to a rhetorical purpose and to a text (Berkenkotter, Huckin, & Ackerman, 1988). Recalling the declarative-procedural distinction, when it is time to generate sentences for readers—and the writers in this study were under some pressure to do so—familiar routines and language in the form of procedural knowledge may have overridden certain intentions and composing behavior. Therefore, years of practice reading for the main idea and structuring summaries of academic content may have circumvented the otherwise original composing found in the protocol transcripts and specifically in otherwise knowledge-sensitive reading behavior (Langer, 1984a).

If translating a reading plan into a writing plan is difficult for expert writers, writing instructors should not be surprized if writers, new to a genre or subject matter, either aspire to an authority and style they do not yet possess (Bartholomae, 1985) or rely on practiced and utilitarian arguments, evidence, and language. The performance of expert composers in this study, who faced a less-familiar topic, is a reminder that writers with varied levels of topical experience will, in constrained circumstances, choose an expeditious path. If a draft does not fit the expectations of an audience or assignment, and if multiple readings in a relatively unfamiliar area are involved, educators need not assume that a more desirable

writing plan is impossible or that supporting strategies and habits of mind are nonexistent. In terms of classroom practice, synthesis assignments may require extra attention to the negotiation of new and text-based ideas and their translation into public discourse. Findings in this research suggest that negotiating and translating prior and published knowledge is a perennial problem for many writers responding to a range of academic tasks.

To conclude, findings from this study generally support theories of reading and writing which give equal play to a composer's knowledge, intentions, and literate ability. In future studies of reading, writing, and knowing, researchers might explore further how various forms of knowledge manifest themselves in comprehension and composing processes and how knowledge appears in both processes and products. In this study, for example, the link between disciplinary membership and explicit elaborations is at best circumstantial, as was the presence of elaborations and the appearance of new information in essays. It also remains important for researchers to explore how writing serves as a unique perspective or goal in reading comprehension and how reading and writing contribute to analytic thinking and learning (cf. Tierney, Soter, O'Flahavan, & McGinley, 1989). Reading and writing researchers can learn from each other, and the knowledge brought and applied to complex, literate tasks remains fertile ground for inquiry.

Notes

1. The concept of constructivism is not unique to literacy theory or cognitive-based theories of comprehension and composing. Educational philosophers dating back to Dewey and Piaget have used the notion of a constructed reality to help explain developmental differences. Also, more contemporary advocates of qualitative research paradigms have used constructivism as a supporting theory for subjective and non-experimental research methodologies. In this research, the term constructivism originates with knowledge-based accounts of reading comprehension and and is used to conjoin related theories on the role of prior knowledge in reading and writing.

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Appendix A

Example Essay Parsed for Content Units and Scored for Heights, Importance, and Origin

Supply-side Economics:
Direct Benefits of Analysis and Implied Indirect Benefits by Comparison to the Field of Psychology

SV	O	e	
1-1-1	I		*Supply and demand have always been inseparably linked in the study of economics
1-1-2	I		*However, at times, the supply-side of the relationship has held more sway over the economic policy makers
1-1-3	I		And at other times, the demand side of the relationship has reigned supreme.
1-1-4	E	C-0	*For instance, Adam Smith's Wealth of Nations emphasized the supply side
1-1-5	E	A-71	*Demand side economics has been popular in the United States since the 1930's
1-1-6	N		This is so) as a counter example, and one of more relevance to our lives today
1-2-1	I	A	*Economic conditions in the 1930's made demand side economics the correct choice of policy makers
1-2-2	E	A-26	Increasing the "effective demand" (was) the top priority of government
1-2-3	E	A-27	There was) little need to consider the effects of high inflation, high interest rates, or material shortages
1-2-4	E	A-28	Unemployment, excess capacity, falling prices, low interest rates, and mass poverty made (it so)
1-2-5	I	A	*Increasing the effective demand may no longer be the top priority
1-2-6	E	C-10	(It is) reduced in importance relative to the manipulation of the aggregate supply curve
1-2-7	I	A	(This is so) now, however, when these dire conditions no longer exist
1-3-1	E	A-62	*Demand side economics emphasizes "demand management"
1-3-2	E	B-8	(This is) where the government directly manipulates public demand for products and the consumer demand
1-3-3	E	B-9	(It does) through policies like deficit spending and through policies like printing money
1-3-4	I	B	The main difference between demand-side and supply-side economics is (this)
1-3-5	I	C	*Supply side economics emphasizes more indirect manipulation of the economy
1-3-6	I	C	(It does so) by government supplying incentives to businesses to increase the supply of goods
1-3-7	I	C	(Incentives are supplied) to individuals to increase workforce and productivity
1-3-8	E	C-43,44	(As examples of) cutting taxes and removing restrictions to business growth and risk-taking
1-3-9	N		*The analyses provide new alternatives to the old problem of having every person live above the level of poverty
1-3-10	N		One direct value of the new emphasis on supply side economics is (this)
1-4-1	I		(SSE) suggests it
1-4-2	I		*For instance, demand side economics tries to increase consumer demand
1-4-3	N		(It does so) by giving unemployed people welfare
1-4-4	E	C-49	*Cutting welfare programs would encourage people to move to an area where they could find productive employment
1-4-5	E	C-50	(They would do so) rather than stay in a depressed area
1-5-1	N		(This is) a win for both the individual and the country as a whole
1-5-2	I		On the other hand, supply side economics indicates (this)
1-5-3	I		*Many of the provisions of (tax) laws are the direct benefits of supply side economics
1-5-4	N		(This is so) if we take as given that the new tax laws are good
1-5-5	N		*Family's) tax burden has decreased under the new laws
1-5-6	N		For example, most families are supposed to find (this)
1-5-7	E	C-54	*Lower taxes encourage savings
1-5-8	N		(This is so) because people will actually have something to save rather than living on the edge of their finances
1-5-9	E	C-40	Lower taxes) encourage more people to work longer hours
1-5-10	C		(This is so) because less of their income is going to the government
1-5-11	C		(This) increases national productivity
1-5-12	N		*The new tax laws are also supposed to be easier to file
1-5-13	N		Thus (they) free people from the need for tax consultants
1-5-14	N		And (they) release that part of their income for savings or productive enterprises
1-5-15	E	C-54	*Closing the loopholes will also have that same effect
1-6-1	N		The new laws promises (this)
1-6-2	N		*These aspects of the new laws can be directly attributed to supply side economics
2-1-1	I		*Other indirect benefits may also come from simply considering supply side economics
2-1-2	M		*For instance, supply side economics is not going to be the solution to all the world's ills
2-1-3	E	C-84	But it "may yet prove to be the irritant which produces a pearl of new economic wisdom"
2-1-4	E	C-86	(This is) like the grain of sand in the oyster shell
2-1-5	E	C-76	Sweet (used this in) 1980
2-2-1	N		*This "grain of sand" effect has been observed in other fields
2-2-2	N		(It has) when a new way of thinking comes along
2-2-3	N		*As an example, consider the field of psychology
2-3-1	N		*Psychology was dominated for many years by a philosophy called "behaviorism"
2-3-2	N		Only "observable" behavior was valid in understanding the working of the mind
2-3-3	N		The main reason for (it) was that
2-3-4	N		*Behaviorism was a reaction to arm-chair introspection
2-3-5	N		Where a psychologist would think about how he would accomplish a task
2-3-6	N		He would) declare that anecdotal method to be true about how all humans accomplished the same task
2-3-7	N		It would be for) dogs, or rats for that matter
2-3-8	M		*The philosophy of behaviorism made certain research techniques to be the only acceptable means of doing science in the field
2-3-9	N		It made the same for) even certain research questions
2-3-10	N		*This can be compared to demand side economics
2-3-11	I	C	(It) emphasizes the manipulation of the demand curve
2-3-12	M	B-9	(This) made solutions involving deficit spending and money printing acceptable solutions
2-3-13	I	A,B	*Not only were solutions maneuvering the supply curve not acceptable
2-3-14	M		But the question of how to manipulate the supply curve was never even asked
2-4-1	N		*Information given to an organism is processed by that organism
2-4-2	N		Every output of that organism is a product of that processing
2-4-3	N		And every product of that processing is valuable to understanding the functioning of the organism
2-4-4	N		A new idea in psychology called information processing introduced (these) notions
2-4-5	N		*What a persons thinks or says is just as much a piece of behavior as how many times a rat presses a lever
2-4-6	N		(The first is) unobservable as data to the behaviorists
2-4-7	N		(The second is) acceptable to the behaviorists
2-4-8	N		A direct result of these notions is (this)
2-4-9	N		*New phenomena were discovered
2-4-10	N		(They were) with verbal traces of a person's problem solving behavior as admissable evidence
2-4-11	N		*"I have to make this peg empty so I can move this disk onto it"
2-4-12	N		The psychologist now had to account for a statement like (it)
2-4-13	N		* Accounting for such statements necessitated the existence of internal goal states
2-4-14	N		This was) something never allowed within the behaviorist framework
2-4-15	N		*Psychologists) ask questions about the goals necessary to accomplish a task and how behavior relates to those goals

Appendix B

Analysis of Variance for Various Process and Product Measures

Two-way ANOVAs (Mean Squares) and F Scores

Feature	Discipline	Topic	Interaction
Evaluative Elaborations[a]	(92.45) 0.79	(76.05) 0.65	(708.05) 6.08*
Content Awareness During Writing[a]	(696.20) 4.74*	(64.80) 0.44	(156.80) 1.07
Length in Content Units[b]	(532.90) 0.65	(774.40) 0.95	(902.50) 0.30
Time on Task[b]	(748.23) 0.73	(714.03) 0.70	(275.63) 0.27

[a] $df = 1/16$ [b] $df = 1/36$ * $p < .05$

ANOVA with Task Representations as Grouping Variables

Process Features[a]	MS	F	Product Features[a]	MS	F
Total Rhetorical Awareness	220.17	0.37	Time on Task	1698.04	1.54
Awareness of Structure	54.20	0.46	Length	1802.99	4.18*
Awareness of Context	21.27	2.55	New Information	3411.90	62.05***
Total Elaborations	1904.22	3.91*	Borrowed Information	380.02	0.84
Evaluative Elaborations	581.05	6.26**			

Scheffe's F Test for Multiple Comparisons among Task Representations

	Text-based vs. Text + Writer		Text-based vs. Writer + Text		Text + Writer vs. Writer + Text	
Process Features						
Total Rhetorical Awareness	-9.92	0.33	-9.64	0.20	0.28	1.80
Awareness of Structure	-2.14	0.08	4.11	0.18	6.25	0.46
Awareness of Context	-7.21	1.18	-12.68	2.36	-5.47	0.48
Total Elaborations	-9.60	0.37	-38.21	3.82*	-28.61	2.33
Evaluative Elaborations	-5.48	0.64	-21.14	6.13*	-15.67	3.66*
Product Features						
Time on Task	-17.24	0.53	-36.07	1.50	-18.83	0.45
Length	-0.59	1.57	-33.89	3.39	-33.31	3.56*
New Information	-2.00	0.14	-47.25	51.68*	-45.25	51.56*
Borrowed Information	-1.57	0.01	14.43	0.59	16.0	0.79

[a] $df = 2,17$ * $p < .05$ ** $p < .01$ *** $p < .001$

Time as a Covariate with Process and Product Features

Process Features[a]	MS	F	Product Features[b]	MS	F
Total Elaborations	370.42	0.71	Length	2907.03	3.81
Total Rhetorical Awareness	271.87	0.48	New Information	517.39	1.35
Awareness of Context	136.70	0.24	Importance: Level 5	110.89	1.88
			Importance: Level 4	265.45	2.43

[a] $df = 1,17$ [b] $df = 1,37$

ANOVA for Protocol vs. Non-protocol Conditions

Process and Product Features[a]	MS	F
Time on Task	874.23	0.88
Length	1299.60	1.61
New Information	1040.40	2.37
Borrowed - Explicit Information	10.00	0.13
Borrowed - Implicit Information	3.03	0.02
Importance: Level 5	3.60	0.06
Importance: Level 4	225.63	1.87

[a] $df = 1,38$

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